

BALTIMORE INNER HARBOR, PIER 5  
South side of Pratt Street, between  
Market Place and Concord Street  
Baltimore City  
Maryland

HAER No. MD-86-A

HAER  
MD,  
4-BALT,  
225A-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD  
National Park Service  
Northeast Region  
U.S. Custom House  
200 Chestnut Street  
Philadelphia, PA 19106

# HISTORIC AMERICAN ENGINEERING RECORD

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MD  
4-BALT  
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**Baltimore Inner Harbor, Pier 5**

**HAER No. MD-86-A**

Location: South of Pratt Street between Market Place and Concord Street  
Baltimore, Maryland

UTM: 18.362520.4349390 361492.4349374  
Quad: Baltimore East, Maryland

Dates of Construction: 1908-1910; 1984

Engineer: 1908-1910 - Oscar F. Lackey, Chief Engineer, Baltimore Harbor Board  
1984 - Whitman, Requardt and Associates

Present Owner: City of Baltimore

Present Occupants and Uses: Connolly's Seafood Restaurant (Vacant; demolished October 1992)  
Harrison's Pier 5 (Hotel and Restaurant)  
Seven-Foot Knoll Lighthouse (Vacant; Commemorative)  
Surface Parking

Significance: Designed by Oscar F. Lackey and constructed in 1908-1910, the bulkheads on Piers 4, 5, and 6 in the Baltimore Inner Harbor were among the first reinforced concrete structures erected in seawater in the United States. These and other early concrete piers in the U.S. pioneered the acceptance of reinforced concrete in American harbors. The solid piers, consisting of filled reinforced concrete bulkheads, played a significant role in the evolution from timber pile to reinforced concrete for seawater construction.

Project Information: Betty Bird, 2025 Eye Street, N.W., Suite 801, Washington, D.C. prepared documentation from March 1992 through March 1993 under contract to Christopher Columbus Center Development, Inc. The Christopher Columbus Center for Marine Research and Exploration, an underwater archeology and marine research and education center, will construct a facility on Piers 5 and 6 that will require reinforcement of deteriorated concrete bulkheads on Piers 4, 5, and 6. Reinforcement will be constructed in front of existing material, obscuring the original concrete cylinders and sheet piles. This documentation was completed pursuant to 36 CFR 800 to mitigate the adverse effects of this undertaking.

### DESCRIPTIVE INFORMATION

Pier 5 is a solid pier consisting of back-filled concrete bulkheads. The pier extends south from East Pratt Street west of Concord Street into the Baltimore Inner Harbor. The Inner Harbor is located on the Northwest Branch of the Patapsco River, which empties into the Chesapeake Bay.

Pier 5 was part of a 1904-1910 harbor improvement that originally consisted of 6 trapezoidal piers extending south into the Inner Harbor between Light Street and Jones Falls. These piers were constructed on the site of similar solid piers that had been thickly settled prior to the Baltimore Fire of 1904. As designed, Pier 5 was originally 1058.5 ft. long on the west and approximately 1300 ft. long on the east. The head of Pier 5 was 205 ft. wide. Beginning 680 ft. from Pratt Street, the pier flared out to the east so that the southern face was wider than the head of the pier at Pratt Street.

The original construction of the piers is depicted in engineering drawings. The following description appeared in 1909 in *The Engineer*, a British publication:

The face structures consist of series of steel cylinders, filled with concrete, connected by reinforced concrete sheet piling, and the superstructures are of reinforced concrete or masonry. The cylinders are 10 ft. in diameter, and built of 3/8 in. steel plate, stiffened by 3 in. by 3 in. by 3/8 inch angles. They are sunk to a depth of 27 ft. below low water and spaced 25 ft. centres. . . .

In the typical section the floor is carried by two 15 in. -- 45 lb. per foot -- steel channels on the face of the cylinder, and a 4 in. thick reinforced concrete wall in the rear, the wall resting directly on the top of the sheet piling. The latter is of reinforced concrete, gauged in the proportions of 1 cement, 2 sand, and 4 crushed stone or gravel. The piles are 18 in. wide by 12 in. thick, with four 3/4 in. steel bars in tension and four 3/8 in. square bars in compression. The longitudinal reinforcement is connected by 5/16 in. round steel hoops placed 18 in. apart. On the water side the reinforcement is covered by 2 in. thickness of concrete. The outward thrust of the sheet piling at the top is taken by a steel lattice girder, embedded in concrete, placed at a distance of 4 ft. to 5 ft. behind the face line of the pier. The girder, which is 2 ft. 6 in. deep horizontally, consists of four 6 in. by 6 in. by 7/8 in. angles double braced with 3 in. by 1/2 in. flat bars spaced 14 in. centres. The cylinders are tied back to anchor beams and piles by means of eight 1-1/8 in. square steel bars to each cylinder, or 25 ft. apart centre to centre of tie clusters. The tie bars are embedded in concrete measuring 18 in. by 10 in. in section. The anchor beam is 28 ft. back from the face line of the pier, and consists of concrete 3 ft. deep and 15 in. thick, reinforced by eight 1-1/4 in. square bars. The anchor beam rests on and is tied to two 15 in. diameter reinforced concrete piles abreast of each cylinder.<sup>1</sup>

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<sup>1</sup>"New Harbour Works at Baltimore," *The Engineer*, January 29, 1909, pp. 105-107.

The physical appearance of the pier has changed more than its structure. Historic photographs and Sanborn maps depict steel-frame metal warehouse structures along the western and southern side of Pier 5. A major fire on February 12, 1968 destroyed all the buildings on the pier with the exception of Connolly's Seafood Restaurant, at the northwest corner of Pier 5.

Although the basic structural system of Pier 5 remains, the original bulkheads are presently in deteriorated condition. Several engineering studies conducted over the past 20 years have documented the condition of this resource. A 1973 feasibility study by Whitman, Requardt and Associates assessed the condition of Piers 4, 5, and 6. Whitman, Requardt found deterioration that was particularly severe toward the southern ends of the pier, which had been subjected to the greatest turbulence. Steel jackets encasing the cylinders had eroded and cylinders were disintegrating. The top portions of many of the cylinders were missing and remaining cylinders had holes. The beam at the face of the pier was damaged in several places. Concrete sheet piling was in "poor condition" and had shifted in several locations creating voids behind the sheeting. The timber fender system, which was continuously altered and replaced over the years, was still present, in good repair only in areas of use. In describing the condition of Pier 4, which also prevailed in Piers 5 and 6, Whitman, Requardt wrote,

In general the concrete used for the beams, girders, and cylinders is of very poor quality. Pieces can be easily removed or chipped away. Examination of such pieces reveals that there was insufficient cement paste to completely fill the voids in the aggregate. In addition such pieces can be easily crumbled by hand.<sup>2</sup>

The most significant changes to the pier took place in the 1980s. In 1984 the northern 2/3 of the slip between Piers 5 and 6 was infilled to form a parking area.<sup>3</sup> The infill joined Piers 5 and 6 into a single U-shaped entity, altering the original configuration and individual identity of Pier 5. Further changes took place when Harrison's, the hotel/restaurant located at the southern end of the pier, was built in the late 1980s. Construction of a relieving platform involved "partial demolition, abandonment and replacement of the southern portions of the Pier 5 bulkheads." A new pier face was built approximately 3.5 ft. in front of the original face and a steel sheet pile bulkhead was inserted approximately 16 ft. behind the original concrete sheet pile.<sup>4</sup> Because of the rebuilding of the bulkheads, the only remaining original bulkheads are located on the northern 2/3 of the west side of the pier.

Structures presently on the pier include Connolly's Seafood Restaurant (HABS No. MD-1067), parking kiosks at the center of the pier, a late 1980s low-rise brick hotel and restaurant (Harrison's) at the southern end of the pier, and the Seven-Foot Knoll Light, an historic Chesapeake Bay Lighthouse relocated to the southern tip of the pier. The remaining surface of the pier was entirely paved over in the late 1980s for parking.

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<sup>2</sup>Whitman, Requardt and Associates, "Engineering Feasibility Report: Inner Harbor East," p. I-3.

<sup>3</sup>Rummel, Klepper & Kahl, "Engineering Feasibility Analysis," p. ii.

<sup>4</sup>*Ibid.*, p. III-4.

## HISTORICAL INFORMATION

Designed by Oscar F. Lackey and constructed in 1908-1910, the bulkheads on Piers 4, 5, and 6 in the Baltimore Inner Harbor were among the first reinforced concrete structures erected in seawater in the United States. These and other early concrete piers in the U.S. pioneered the acceptance of reinforced concrete in American harbors. The solid piers, consisting of filled reinforced concrete bulkheads, played a significant role in the evolution from timber pile to reinforced concrete for seawater construction.

The Baltimore Harbor Board built the Inner Harbor piers on the site of earlier filled piers that the devastating fire of February 1904 had reduced to rubble. (Please see Baltimore Inner Harbor, HAER No. MD-86 for information about the rebuilding of the Inner Harbor.) Oscar F. Lackey (1874-1928) joined the Harbor Board in 1906. Lackey was born in Washington, D.C. but grew up in Baltimore, graduating from Johns Hopkins with a degree in civil engineering in 1896. He joined the War Department as an engineer and in 1897 was sent to Santiago, Chile to work under General Leonard Wood. After a bout of yellow fever, he designed docks in Cuba and then went to Panama to work on construction of the Panama Canal. In 1906 he returned to Baltimore as the Principal Assistant to N.H. Hutton, the Chief Engineer and President of the Harbor Board. When Hutton died shortly thereafter, Lackey succeeded him as Chief Engineer, a position he held until he left the Harbor Board in 1915 to join Poole Engineering. During this period Lackey served as one of five directors of the Association of Seaport Authorities and as president of the Association of Port Authorities.

In 1918 Lackey was appointed Supervising Engineer in the War Department. His responsibilities included construction of port terminals in Boston, Philadelphia, Brooklyn, Norfolk, New Orleans, and Charleston. In 1921 he returned to Cuba as a consulting engineer and after returning to the United States served as a consulting engineer on several harbor projects. From 1924 to 1927 he was head of the Transportation Bureau of Baltimore and shortly before his death in 1928 he was appointed Chairman of the State Roads Commission of Maryland to review plans for the proposed Bay Bridge.<sup>5</sup>

Because of his international experience and particularly his work on the Panama Canal, Lackey possessed a vision of the harbor facilities Baltimore required to be competitive during the 20th century. Lackey advocated municipal ownership of all harbor facilities as early as 1908, pressing for a \$50 million loan for harbor improvements.<sup>6</sup>

While construction of Piers 1, 2, and 3 had employed traditional methods and materials, Piers 4, 5, and 6 were of reinforced concrete construction. The use of reinforced concrete for seawater construction was highly controversial as late as 1915. Lackey is credited with being among the first in the United States to employ this method. His obituary stated that, "he was one of the first, if not the first, engineer to utilize reinforced concrete piles in pier construction."<sup>7</sup> In his extensive world-wide

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<sup>5</sup>Ezra B. Whitman, "Memoir of Oscar Francis Lackey, M. Am. Soc. C. E." in *Transactions of the American Society of Civil Engineers* Vol 93, pp. 1863-1864; Obituary, *Baltimore Sun*, December 20, 1928.

<sup>6</sup>*Harbor Board Report for 1908; Harbor Board Report for 1910*, p.33.

<sup>7</sup>Whitman, p. 1863.

study of reinforced concrete docks undertaken in 1915, Harrison S. Taft could not determine which was the first complete reinforced concrete dock in the U.S.

A study of the constructive dates of concrete pile or concrete column docks would indicate that such types began about 1905 or 1906. Still, it is not evident which was the first of such docks to come into existence, the whole development being a gradual evolution from a concrete-filled steel cylinder column, steel deck-beams, and concrete-slab type, as used in the Philippines by the United States Government in 1902.

Irrespective of the actual beginning of constructing reinforced concrete docks, it is generally conceded that Oscar F. Lackey, M. Am. Soc. C.E., Harbor Engineer of Baltimore, was among the first, if not the first, to blaze the way for the extensive use of reinforced concrete in dock construction in United States harbors.<sup>8</sup>

Because of their early date, Piers 4, 5, and 6 played an important part in the evolution from traditional pile and timber construction to reinforced concrete. At the turn of the century, mathematical analysis of structures and the study of strength of materials were based on empirical experience. Engineering practice was thus strongly biased in favor of traditional approaches. Without compelling reasons to innovate, the success and endurance of structures that had worked in the past constituted a powerful argument for their continuation. While concrete had been used successfully in bridge caissons and other construction work in fresh water rivers and lakes, its use in seawater posed serious problems. American engineers had little experience using concrete in brackish water. Salt water affected both the strength and the durability of the material. In his 1915 survey, Taft found that "in the United States the construction of reinforced concrete docks is in a very embryonic state, and the use of cement in structures standing in sea water, on the part of American engineers, has not always been successful. On the other hand, concrete has been used successfully for more than 50 years in Europe for structures exposed to the action of salt water, and English engineers have been building reinforced concrete docks for about 20 years."<sup>9</sup>

Deforestation provided the incentive for European engineers to devise alternatives to timber docks and to address the problem of concrete and seawater. Concrete's wide use in European ports gave European engineers a familiarity with the material and its limitations that encouraged the development of reinforced concrete harbor construction. In the United States, where timber was both plentiful and cheap, concrete was seldom used and there was little justification to understand the material.<sup>10</sup>

Timber offered numerous advantages that discouraged innovation, not the least of which was its low initial cost. Pile and timber construction produced a flexible structure that could easily absorb the shocks and poundings inherent in docking boats and barges. Because timber construction consisted of discrete elements, it could be easily modified and components replaced and repaired without affecting

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<sup>8</sup>Harrison S. Taft, Esq., "Reinforced Concrete Docks: Foreign and American Structures. Failures, Costs, and General Considerations," in *Transactions of the American Society of Civil Engineers* (1915), p. 1096.

<sup>9</sup>Taft, p. 1058.

<sup>10</sup>Taft, p. 1060.

the entire structure. While timber piers usually lasted about 15 years,<sup>11</sup> this short life span was advantageous since harbors continually changed to meet new requirements of ever larger ships.<sup>12</sup>

Nevertheless, timber construction had shortcomings that were to become increasingly problematic. Pile and timber docks required constant ongoing maintenance and repair. The teredo worm and other marine borers that attacked wood constituted a potentially devastating menace. Once confined to tropical waters, the index to the *Transactions of the American Society of Civil Engineers* show that they had become an acknowledged problem in the United States by the 1890s. The filth present from dumping city waste and sewerage in 19th century harbors checked the teredo in most northern U.S. ports. However, as municipal sewage systems were established and harbors cleaned up, the teredo multiplied. By the second decade of the 20th century, the teredo had been found in Atlantic ports up and down the east coast. So destructive was this worm that it could cut through large timber piles in only a few months.<sup>13</sup> The switch from coal to fuel oil for steamships constituted an additional problem because of the danger from fire caused by frequent oil spills.<sup>14</sup>

Beyond inherent conservatism within the American engineering profession that maintained its preference for timber docks, concrete as a material had numerous shortcomings. Widespread, well-publicized failures in the United States and its territories had discouraged its use. In seawater, concrete was subject to a host of problems. Salt increases corrosion causing steel reinforcing to rust and fail and the reinforced concrete to lose its integrity and to disintegrate. Any permeability in the material permits corrosion to attack the steel. Freeze-thaw cycles especially threatened the integrity of the material. The rigidity of concrete posed another drawback. While timber structures could accommodate shocks from collisions, concrete structures required fender systems to absorb blows. To protect the integrity of material, docks required monolithic structural design. While this approach reduced the number of joints, it further intensified the rigidity of the structure. An additional difficulty in the acceptance of concrete in the United States was that the best construction systems required patented features forbidden by municipal bidding regulations.<sup>15</sup>

Because of the controversy surrounding the use of concrete in seawater and the lack of experience with it in the United States, Piers 4, 5, and 6 played an important role in demonstrating that the material could be used with success and in providing cost data that helped establish an economic rationale for using concrete in other situations. The 1913 Annual Report of the Harbor Board recalled that "plans for the first concrete piers ever constructed in this country, after a hard fight on the part of the Harbor Board, were approved."<sup>16</sup> In their 1907 Annual Report, the Harbor Board cited the following reasons for using concrete for Piers 4, 5, and 6:

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<sup>11</sup>Taft, p. 1110.

<sup>12</sup>W.J. Barney, Discussion of timber vs. concrete piers, *Transactions of the American Society of Civil Engineers* (1915), p. 1113.

<sup>13</sup>Eugene W. Stern, Discussion of concrete as material for piers, *Transactions of the American Society of Civil Engineers* (1915), p. 1115.

<sup>14</sup>Taft, p. 1068.

<sup>15</sup>Charles W. Staniford, "Modern Pier Construction in New York Harbor" in *Transactions of the American Society of Civil Engineers* (1914), p.563.

<sup>16</sup>Harbor Board Report for 1913, p. 68.

the Harbor Board has adopted the use of concrete and steel for construction of Piers 4, 5 and 6 in preference to that of pile and timber for several reasons:

- 1st. It is cheaper
- 2nd It is more durable, stronger and better suited to the conditions of the harbor, and it is permanent.
- 3rd The work can be carried on without any great interference by tides, which has been the main cause of delay in the construction of Piers 1, 2 and 3.
- 4th The piers present a better appearance.
- 5th The cost of maintenance is very materially decreased.
- 6th Provision is made, for those desiring, for the erection of sheds either of steel or of timber.
- 7th We feel that as the water of the harbor becomes less polluted, due to the diversion of sewerage now emptying into same, such sewerage being taken up by the new sewerage system, that the "teredo," a most destructive worm, will make its appearance. This has happened in other ports under similar conditions. This worm, which eats its way into the timbers, chiefly between the M.L. and M.H. water lines, can be found as far up as Sparrows Point. At Annapolis all piles are protected by concrete or otherwise against the "teredo," which doubles the cost of construction. For this reason, if for no other, this Board does not think it advisable to put out a great amount of money for the construction of piers, which in all likelihood will in the course of a few years require a large additional expenditure to make them safe.<sup>17</sup>

The teredo had been present in Annapolis since 1886 and in Norfolk since the Civil War. The worm had traveled up the Chesapeake Bay as far as Bear Creek prior to the reconstruction of the Inner Harbor. The likelihood of the teredo appearing in Baltimore was controversial. In addition to the sewerage pollution, many maintained that the Inner Harbor was not brackish enough and that the amount of oil in the upper harbor would discourage the worm's spread.<sup>18</sup> However, in 1914 the Harbor Board was vindicated. When old piers constructed in the 1870s were removed from the location of the Commercial Pier at Broadway, timbers were found "riddled by the teredo." The Harbor Board concluded, with some satisfaction, that this damage demonstrated that the teredo had been active in Baltimore Harbor prior to the extensive pollution of the late 19th century and that the worm would reappear when the sewerage problem was abated.<sup>19</sup>

Oscar F. Lackey and engineers at the Harbor Board designed Piers 4, 5, and 6. Like other early concrete docks in the U.S., the basic form of the Baltimore piers appears to be derived from the Navy Department's 1902 design for docks in Manila.<sup>20</sup> During 1908, the Harbor Board produced 102 plans,

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<sup>17</sup>*Harbor Board Report for 1907*, pp. 16-17.

<sup>18</sup>*Harbor Board Report for 1908*, pp. 27-28.

<sup>19</sup>*Harbor Board Report for 1914*, pp. 29-30.

<sup>20</sup>Taft, p. 1077.



76 tracings, and 478 blue prints, "principally ... details of the pier construction."<sup>21</sup> The Board opened bids in 1908 and awarded the construction contract to Sanford and Brooks of Baltimore.<sup>22</sup> Sanford and Brooks subcontracted work on the steel caissons to the Maryland Steel Company, which in turn subcontracted with the Snare & Triest Company and Bernard Rolf of New York. Concrete work was subcontracted to Raymond Concrete Pile Company, also of New York. Penniman and Browne, Chemists tested cement; Stulen Company of Harrisburg tested the steel.<sup>23</sup> The City Engineer's Department, compensated by the Harbor Board, paved the piers. Piers 4 and 5 were paved with belgian block on a 6 in. concrete base with tar filler.<sup>24</sup> Pier 5 cost \$385,864.97, \$264,133.34 of which was for land acquisition. The pier had a load limit of 1000 lbs. per sq. ft.<sup>25</sup>

The method of construction adopted represented a shift from the original design of the piers in the bidding specifications. Because the power house on Pier 4 survived the 1904 fire, it was imperative that there be minimal disruption of conduit and other connections between the United Railways and Electric Company power house and the rest of the city. Neither the location of conduit or pipes was known with any precision. Accordingly, tie piles were located immediately back of the cylinders instead of a fixed distance equidistant behind them. Steel rods covered with three inches of concrete then replaced channel ties. Concrete sheet piling could then be driven behind the cylinders without requiring special piling at the location of the channel ties. This simplification, which resulted in both a reduction in cost and more rapid construction, was adopted for the two subsequent piers as well.<sup>26</sup>

The most detailed description of the construction of the piers can be found in a description of Pier 4, the first to be constructed:

steel cylinders, with a cross section 3 feet by 10 feet and 27 feet long, were first driven in 4 foot sections, held together by angles, with additional angles running longitudinally from top to bottom, to prevent collapsing (sic) from water pressure. These cylinders are placed every 25 feet on centers. After these cylinders were set in place, beld by wooden frames, and allowed to settle from their own weight of 7 tons; the material in the interior of the cylinders was removed about two feet below the cutting edge of the cylinder, by a centrifugal pump. The cylinders were then driven to refusal, pumped again, and then driven to the final penetration, and filled with a mixture of 1-3-5 concrete. After the cylinders were driven, lattice girders built of 6 inches, by 6 inch by 7/8 inch angles were anchored from cylinder to cylinder and wrapped with wire fabric, and covered with about 3 inches of concrete to protect the steel, after which reinforced concrete sheet piles 12" by 18", weighing about three tons were driven behind the girders. [Sheet piles were 27 ft. long.<sup>27</sup>] After the sheet piles were driven, two 15 inch channels carrying the front of the wall, and guard rail were

<sup>21</sup> Harbor Board Report for 1908, p. 30.

<sup>22</sup> Harbor Board Report for 1908, pp. 19 and 20.

<sup>23</sup> Harbor Board Report for 1908, p. 24.

<sup>24</sup> Harbor Board Report for 1909, pp. 14-16.

<sup>25</sup> Harbor Board of Baltimore, *Survey of the Port of Baltimore*, Vol. 1, pp. 24-27.

<sup>26</sup> Harbor Board Report for 1908, p. 21.

<sup>27</sup> Harbor Board Report for 1914, p. 26.

placed, and anchored to the cylinders, and covered with wire fabric and concrete. On top of the sheet piling was built a 6 inch reinforced concrete wall, which forms the back support for the 6 inch wall. The ties were placed two above, and two below, at each end of the lattice girder, and then bent over the outer face. They were then tied into a concrete beam reinforced with 9 7-8" bars, and the beam was carried on to form a concrete deadman, and two tie piles placed 30 feet from the wall in virgin ground 6 feet below the finished grade.<sup>28</sup>

The cylinders were preassembled off site and brought to the site in one piece. Sheet piling was cast on site and seasoned for 28 days.<sup>29</sup>

Taft described the completed piers as follows:

It is perhaps at Baltimore that the most extensive reinforced concrete docks on the Atlantic seaboard have been built. Although the water in Baltimore Harbor may not have the same density of salt as in ports nearer the sea, these docks, thus far, have shown no sign of deterioration, though at times subject to frost action....

In general, these three [Piers 4, 5, and 6] docks consist of a series of oval-shaped concrete cylinders 25 ft. apart along the face of the docks, and sunk to about 25 ft. below low water. Along the face of the cylinders, and just above high water, there is a concrete-encased iron girder, tied back to a deadman some 28 ft. in the rear of each cylinder. A row of concrete sheet piling was driven back of the girders to form a vertical retaining wall, the upper ends of the sheet-piling bearing against the girder and the lower ends being driven into the muddy bottom. A horizontal box-girder encased in concrete runs along the upper face of the dock, supporting the outer edge of the concrete curb slab, on which are laid the paving blocks. The cylinders are tied together in certain cases by ties extending entirely across the docks. The face of each dock is protected by wooden fender-piles, 8 ft. apart.<sup>30</sup>

The lozenge-shaped bulkheads appear to have been unique among early reinforced concrete dock work. While the concrete piers met expectations, they still required periodic maintenance and repair. Fenders and waling pieces which absorbed the shocks of collisions were particularly vulnerable and required repair and replacement as early as 1912.<sup>31</sup>

For information on the historic use of Pier 5, please see Connolly's Seafood Restaurant (HABS No. MD-1067).

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<sup>28</sup>Harbor Board of Baltimore, *Survey of the Port of Baltimore*, November 15, 1920, pp. 18-19.

<sup>29</sup>*Report of Harbor Board for 1908*, p. 23.

<sup>30</sup>Taft, p. 1082.

<sup>31</sup>*Report of Harbor Board for 1912*, p. 29.

## SOURCES OF INFORMATION

### A. Engineering drawings:

Working drawings: Collection of Peter Van de Castle (private collection to be donated to the Baltimore Museum of Industry).

Plans, site plans, schematic drawings, and structural diagrams: *Reports of the Harbor Board*, 1904-1914 (Enoch Pratt Free Library)

Structural diagrams. "New Harbour Works at Baltimore," in *The Engineer* (Jan. 29, 1909), pp. 104-106. (Library of Congress)

As built drawings. Harbor Board of Baltimore. *Survey of the Port of Baltimore*, Volume 1, 1920.

### B. Historic views:

Please see Baltimore Inner Harbor (HAER No. MD-86) for information on general views of the Inner Harbor, including Pier 5.

Views of burnt piers: *Reports of the Harbor Board*, 1905-1910 (4 in. x 6 in.)

Views of piers under construction: *Reports of the Harbor Board*, (4 in. x 6 in.)

### C. Interviews:

Karen Connolly, Interviews at Connolly's Seafood Restaurant, March 24, 1992, and numerous telephone conversations. Ms. Connolly's family operated Connolly's Seafood Restaurant at the head of Pier 5.

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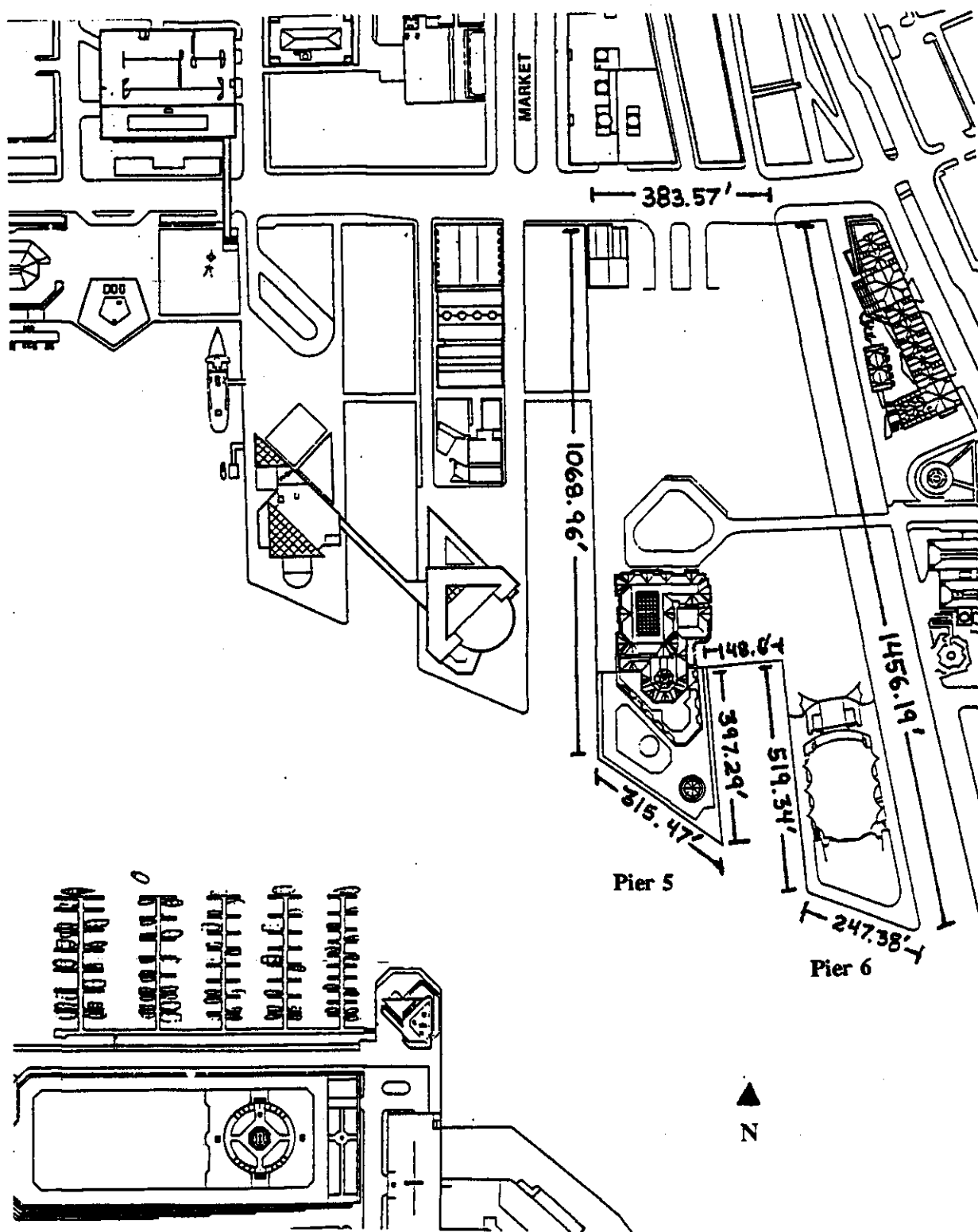
Whitman, Ezra B. "Memoir of Oscar Francis Lackey, M. Am. Soc. C. E.," in *Transactions of the American Society of Civil Engineers*, Vol. 93, pp. 1863-64.

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**E. Likely sources not yet investigated:**

This investigation was focused on the reinforced concrete technology for the bulkheads on Piers 4, 5, and 6. Less attention was devoted to the history and occupants of Pier 5 and a detailed evolution of the harbor. This material can be found in *Reports of the Harbor Board*, Enoch Pratt vertical files, and numerous published histories of the harbor.

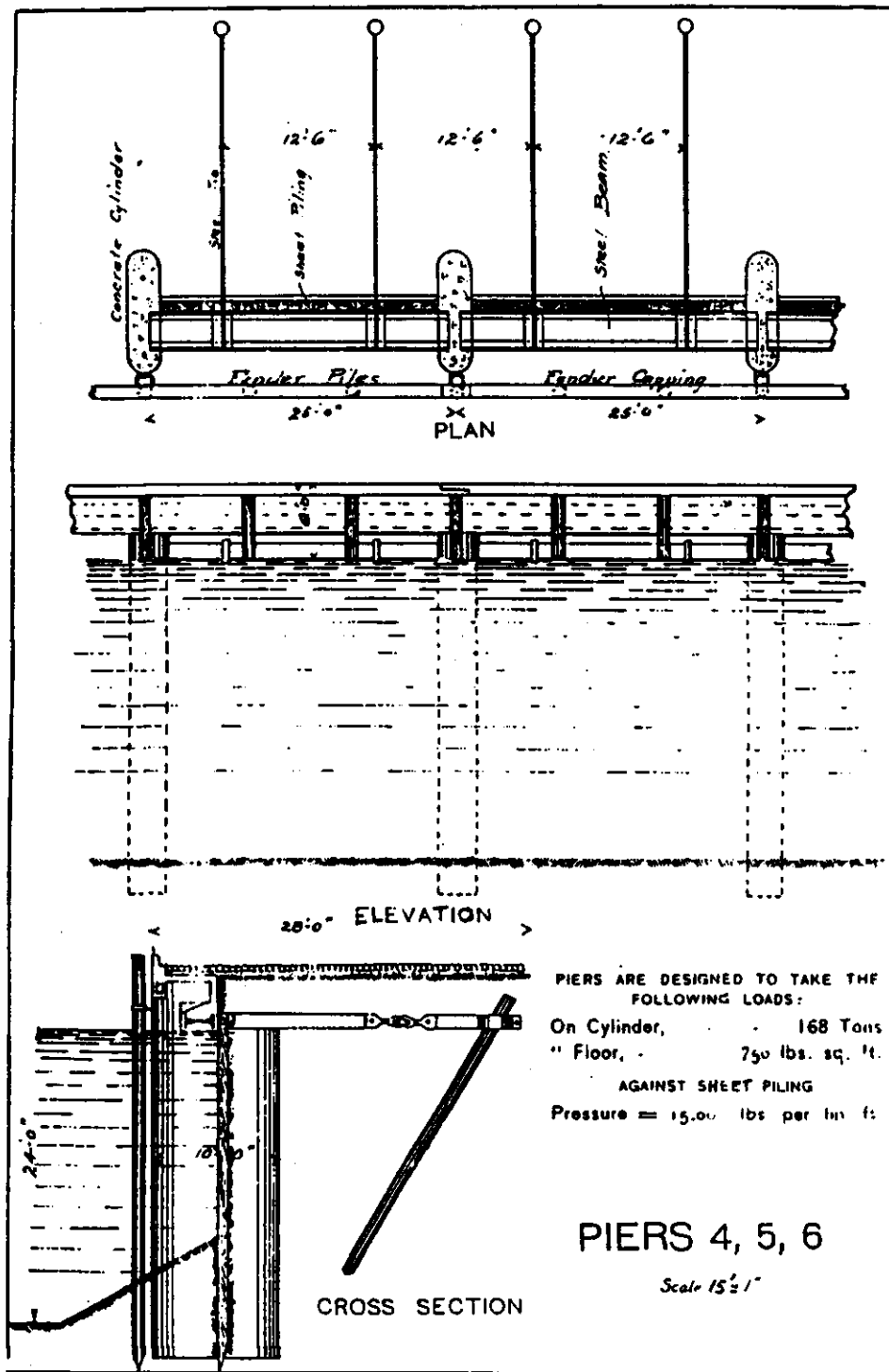
BALTIMORE INNER HARBOR, PIER 5  
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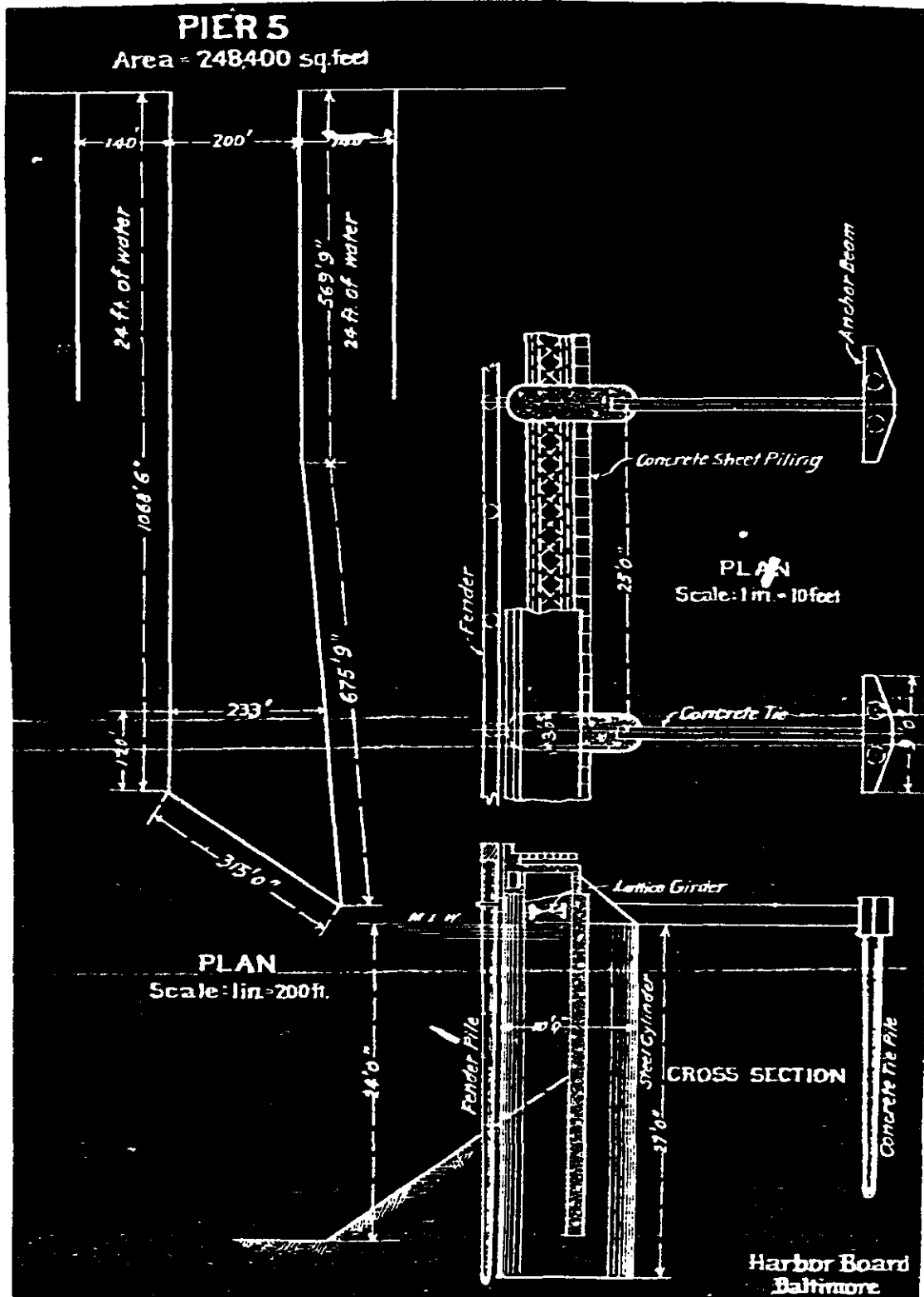
SITE PLAN  
Source: Gannett Fleming, Inc.

Initial Design of Piers Prior to Modification for  
Existing Conditions on Pier 4

PLATE 1



SOURCE: Harbor Board Report for 1907



SOURCE: Survey of the Port of Baltimore (1920)